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Pine Tortoise Scale

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The pine tortoise scale, *Toumeyella parvicornis* (Cockerell), is a soft scale insect (Hemiptera: Coccidae) which infests pines throughout the middle and eastern United States. Though the common name has remained constant, previous taxonomic names in older literature were *Toumeyella numismaticum* (Pet. & McD.) and *Lecanium numismaticum* Pet. & McD. This insect is often a pest in young pine plantations, seed orchards, and Christmas tree farms. Infestations can result in severe economic consequences through impaired tree growth and appearance. Heavily infested trees may be killed, particularly seedlings and saplings.

Range

In the United States, the pine tortoise scale is found in most states east of the Mississippi River. In the West it ranges from North Dakota south through Colorado, and also occurs in southern pines in Texas, Oklahoma, Arkansas, and Louisiana. This scale insect has also been reported from eastern and central Canada, as well as Mexico. In the Carribean, it was introduced into the Turks and Caicos Islands in 2005 and Puerto Rico in 2009.

Hosts

In the northern part of the native range, the primary hosts are jack pine (*Pinus banksiana* Lamb.) and Scots pine (*P. sylvestris* L.), but this scale also infests eastern white pine (*P. strobus* L.), Austrian pine (*P. nigra* Arnold), red pine (*P. resinosa* Ait.), lodgepole pine (*P. contorta* Doug. ex. Loud.), Mugo pine (*P. mugo* Turra), and various species of Chinese pines. In the southern United States, most pine species may be in-

Figure 1. Pine tortoise scale female with mobile and settled crawlers.

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fested, with Virginia pine (*P. virginiana* Mill.), slash pine (*P. elliottii* Engelm. var. *elliottii*), and shortleaf pine (*P. echinata* Mill.) the most common hosts. Caribbean pine, *P. caribaea* Morelet var. *hondurensis* (Sénéclauze) W.H.Barrett & Golfari, has been attacked in Puerto Rico, while a different variety endemic to the Bahamas archipelago, *P. caribaea* var. *bahamensis* (Grisebach) W.H.Barrett & Golfari, is the host tree on the Turks and Caicos Islands.

Description

The eggs are small, pinkish, and ovoid. The first instar nymphs are the mobile stage and are known as crawlers (Figure 1). The crawlers are reddish with a flat oval shape, and have six short legs. Once the first instars select a settling site, they remain in place and the legs become greatly reduced. Females have three nymphal instars and an adult stage, while males have two nymphal instars, followed by the prepupa, pupa, and adult stages.

The pine tortoise scale has two morphological forms based on the settling site: a shoot or twig form and a needle form. Adult females on the twigs are convex and hemispherical, sometimes with flattened edges, giving them the tortoise shell appearance that prompted the common name (Figure 1). As the female enlarges, the exoskeleton becomes darker and harder, changing from yellowish or pinkish-tan to reddish-brown or brown. Adult females on the shoots are 3-4 mm in diameter. Markings on the body are usually black, and are darker than the rest of the insect. This pattern differentiates the pine tortoise scale from the similar striped pine scale, *T. pini* (King), which is brown with white or cream markings and is larger in size. Females on the needles are elongate, and their body width conforms to the needle width (Figure 2). Nymphs are light green with darker greenish-gray stripes, turning brown with blackish markings when mature. Settled crawlers and females of both forms may be covered with a fine, powdery wax (Figure 3), which eventually becomes a waxy glaze over the body surface of the adults (Figure 1).

First instar male nymphs are indistinguishable from the female crawlers. When settled, they become elongate and secrete a white wax covering called a test (Figure 4) in which the subsequent stages develop. Males are

Figure 2. Needle form of female pine tortoise scale (center), with male inside test (left).

smaller than females and average about 1.5 mm in length. Adult males are brown with one pair of white wings and a posterior, pointed penial sheath.

Pine tortoise scales have long, piercing-sucking mouthparts called stylets. The stylet is inserted into the plant to suck the sap.

Figure 3. Females on the shoot covered with white wax.

Life History

The pine tortoise scale has one generation per year in the northern part of its range, including Colorado and Nebraska. Two generations per year may occur in Maryland, Virginia, and North Carolina. Four generations per year were observed in southern Georgia, and it is uncertain how many generations occur in other southern states. Multiple life stages were found throughout the year in the Turks and Caicos Islands, indicating that the insects do not need to overwinter in mild climates.

In areas with colder winters, the scales overwinter as fertilized, immature females. In the spring, the females develop into adults. Egg production begins after the first growth flush of the host pine. The eggs are laid singly or in short chains, and are kept beneath the body of the female. Females produce approximately 500 eggs.

The crawlers hatch soon after oviposition and begin to crawl to their settling sites. In areas with one generation per year, crawlers appear in June through early July, and may be active for close to a month. Crawlers are present in May and late July in areas with two generations per year. In Georgia, crawlers were active in April and settled quickly. Subsequent generations begin to overlap, and crawlers may be present from late May through November.

The male and female crawlers both settle on the same part of the host pine, either the shoots or the needles. The sex-

Figure 4. Empty test of a male pine tortoise scale (center) and needle form female (left).

Figure 5. Recently settled crawlers on the new growth.

recorded, with over 100 individuals per inch of shoot. Not all the settled crawlers can survive when overcrowded. Some crawlers may settle on the cones or conelets. Both sexes can complete their development on the cone stems, but only males may be able to reach maturity on the cone surface.

es are indistinguishable at this stage. In general, the shoot or twig form occurs in the northern parts of the range, while the needle form is common in the south. The needle form has been reported on loblolly, slash, longleaf, and Caribbean pines. Only one form is generally present on a tree. New growth is the preferred settling site if available (Figure 5). High crawler densities have been

Figure 6. Pine shoot heavily infested by the pine tortoise scale.

Once the crawlers have settled, the males secrete a test. The males develop quicker than the females. When males reach the adult stage, they back out from the test and crawl or fly to find mates. Mating occurs in the fall in areas with one generation per year. The males mate with immature females and can mate with several partners. Males are short-lived, usually surviving one or two days.

Females continue to enlarge as they develop. When crowded on the shoots (Figure 6), their bodies overlap and the stylet may be the only body part in contact with the plant. The females extrude sugar-rich honeydew. The honeydew may attract ants, wasps, bees, or other insects. It also serves as a substrate for the growth of sooty mold. As honeydew production increases, the shoots and needles may become covered with sooty mold, giving the tree a blackened appearance (Figure 7).

Dispersal is primarily by the wind, with crawlers blown to uninfested material. Crawlers may also be transported by birds, insects, or mechanical equipment. The scales may be introduced into new areas via the movement of infested pines such as seedlings or Christmas trees.

Impacts

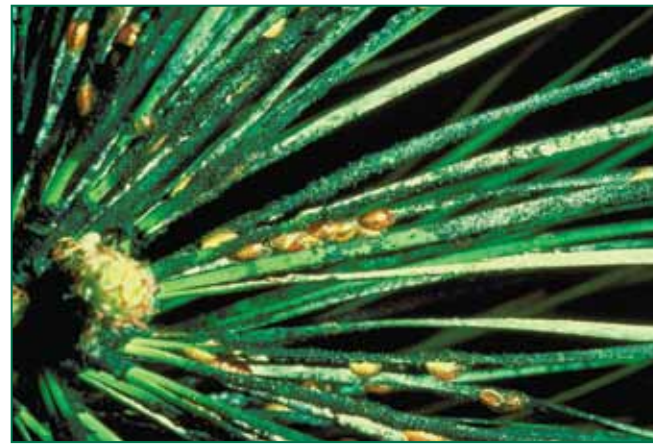

Figure 7. Pine tortoise scales and sooty mold on the needles.

In the continental United States and Canada, the most common impact from pine tortoise scale infestation is reduced growth as a result of insect feeding and reduced photosynthetic activity due to coverage of the needles by sooty mold. Heavy infestations can kill individual branches or the whole tree. Seedlings and saplings suffer the greatest mortality. Infestations in Christmas tree plantations cause dieback or branch deformities, and these cosmetic defects result in economic losses. The effects of infestation on seed and cone production are unknown. Bees, wasps, and ants attracted to the honeydew can be a nuisance to seed orchard and Christmas tree plantation workers. Honeydew may also cover the understory plants beneath infested trees, inhibiting their growth.

The introduction of this scale insect into the Turks and Caicos Islands has threatened the sustainability and integrity of the endemic Bahamas pineyards ecosystem. Infestations have caused severe tree mortality and significantly reduced cone production. Broadleaf species have taken over areas formerly dominated by pine. Endemic pines in Cuba, Hispaniola, and the Bahamas Archiplago are also at risk should the pine tortoise scale continue to spread in the Caribbean.

Natural Enemies and Associates

A variety of predators feed on the pine tortoise scale. Adults and larvae of the ladybugs *Hyperaspis signata* (Olivier), *H. congressis* Watson, *H. binotata* (Say), *Coccinella transversoguttata* Faldermann, *C. trifasciata* Mulsant, *C. novemnotata* Herbst, *Chilocorus stigma* (Say), *Hippodamia convergens* Guérin-Méneville, and *Scymnus lacustris* LeConte have been observed feeding on the scales (Figure 8). The larva of the pyralid moth *Laetilia coccidivora* (Comstock) can destroy most of the female scales on an infested shoot. The caterpillar surrounds the settled females with webbing and consumes all but a portion of their hemispherical

Figure 8. Ladybug adult and two larvae feeding on pine tortoise scale infestation.

exoskeletons (Figure 9). The larva of the dipteran *Leucopis* sp. develops beneath a settled female and eventually ingests the body contents. Lacewings, mirids, spiders, and birds have also been reported as predators.

The parasitoids *Microterys fuscicornis* Howard, *Metaphycus* spp., *Aphytis* sp., *Coccophagus lycimnia* (Walker), *C. immaculatus* Howard, *C. albicoxa* Howard, and other *Coccophagus* spp. have been reared from pine tortoise scales or from infested shoots. Parasitism rates of overwintering females have reached as high as 50% in Michigan. Predators seem to respond to high scale populations, helping to quickly reduce numbers. Ladybugs in concert with *L. coocidivora* have reduced damaging infestations to non-outbreak status within a year. Parasitoids may be important in maintaining low population levels.

Two species of ants, *Formica exsectoides* Forel and *F. obscuripes* Forel, may tend pine tortoise scales on jack pine. The ants remove honeydew and can deter natural enemies, though some ladybugs and parasitoids remain active within the scale insect infestations. The red imported fire ant, *Solenopsis invicta* Buren, and other ant species perform similar functions in the southeastern states.

Predators and parasitoids usually maintain pine tortoise scale populations at low levels in its native range. The pine tortoise scale is considered a secondary pest, and heavy infestations are generally a result of a disruption of the natural enemies by insecticides, dust, or climatic conditions. Aerial insecticide applications targeting other insect pests can promote scale outbreaks. Once infestations develop, insecticide applications should be suspended when feasible to allow natural enemy populations to recover. The movement of infested material outside the typical range of the insect and away from the suite of natural enemies can also lead to outbreaks.

Figure 9. Webbing produced by Laetilia coccidivora *larvae feeding on pine tortoise scales.*

Other hemipteran pests such as the striped pine scale and the mealybug *Oracella acuta* (Lobdell) may also be present within pine tortoise scale infestations.

Direct Control

Allowing natural enemy populations to recover and resume regulating scale insect populations is the preferred suppression method. However, direct control methods are sometimes necessary to reduce pine tortoise scale numbers and prevent additional growth loss and tree mortality. Insecticides should be applied when crawlers or even the second instars are present. The insects are

harder to kill once they begin secreting their waxy coverings and producing honeydew. In areas with multiple generations, insecticide applications should be targeted at the crawlers produced by overwintering females (May in mid-Atlantic states, April in southern states), because generations begin to overlap later in the year. High pressure and/or saturating sprays are required, as many crawlers may be hidden and protected beneath old scales. Aerial applications often are more detrimental to the mobile natural enemies than the stationary scales. Dormant oils have proven effective for control when applied in the fall, but not in the spring. Insecticidal soaps have also successfully suppressed crawlers and second instars. Systemic insecticides and insect growth regulators may have potential for controlling outbreaks. Any insecticides used must be labeled for use against scale insects and for application in the infested habitat type.

Heavily infested trees can be cut and burned. Ant control or exclusion may help reduce pine tortoise scale impacts in plantations. Some trees appear fairly resistant to infestation, and developing and planting resistant strains in Christmas tree plantations could be beneficial. Pine seedlings and Christmas trees from the known range of the scale insect should be inspected for evidence of infestation before export. Insecticidal treatments may be necessary before these materials are shipped into areas with no known infestations.

Additional Information

Private landowners can get more information from County Extension Agents, State Forestry Departments, or State Agriculture Departments. Federal and other resource managers should contact USFS Forest Health Protection (www.fs.fed.us/foresthealth/). This publication and other Forest Insect and Disease Leaflets can be found at www.fs.usda.gov/goto/fhp/fidls.

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